

Executive Summary

Under the auspices of the Delta Science Program, the seven-member Independent Scientific Review Panel (Panel) reviewed the adequacy of the Effects Analysis component of the Bay Delta Conservation Plan (BDCP or Plan). This report represents the third phase of the Effects Analysis review; the Phase 1 (completed in November 2011) and Phase 2 reviews (completed June 2012) were partial reviews of the Effects Analysis and were completed as the Conceptual Foundation and Analytical Approach were still under development. These documents are available online at: <http://deltacouncil.ca.gov/science-program/independent-review-draft-bay-delta-conservation-plan-effects-analysis>. The present, Phase 3 review covers the first complete public draft of the BDCP Chapter 5 Effects Analysis and its associated technical appendices, made available in December 2013.

Four broad themes emerged from the Panel's review of the BDCP Effects Analysis. Firstly, the long, highly detailed document was difficult to review and comprehend. The vastness of the Effects Analysis report and appendices are both its strength and weakness. Although highly improved from the documents that the Panel reviewed during Phase 2, Chapter 5 continues to be fragmented in its presentation and sometimes inconsistent with the technical appendices. While the sheer scope of the analysis is impressive, the inefficient organization and incomplete cross-referencing among sections within the Effects Analysis (e.g., the 8 supporting appendices, totaling ~4500 pages) as well as with the larger BDCP planning documents make interpretation of anticipated net effects of BDCP implementation difficult at best. The 745-page Chapter 5: Effects Analysis does not represent a stand-alone document and it relies extensively on the associated appendices and other chapters for the presentation of scientific information, with insufficient guidance for the reader. As concluded from the Phase 2 report, the Panel universally believes that by itself, Chapter 5: Effects Analysis inadequately conveys the fully integrated assessment that is needed to draw conclusions about the Plan, in part because of incomplete information on factors affecting the covered species.

The second theme in the Panel's review is an apparent disconnect between the assessments of the levels of scientific uncertainty presented in Chapter 5 versus what is characterized in the technical appendices. In many cases, the Panel felt that there was appropriate characterization of high uncertainty within the technical appendices but Chapter 5 did not sufficiently acknowledge or articulate this reality, especially when using professional judgment to reach overall net effects of the BDCP on key species. In particular, the Panel observed that the critical uncertainties associated with presumed beneficial effects of tidal wetland restoration were not recognized in the Chapter 5 summary. Given the magnitude of the BDCP, the inherent natural and anthropogenic complexity in the Bay-Delta ecosystem, and the long time horizon for BDCP implementation and rehabilitated community development, most of the potential BDCP effects carry a relatively high level of uncertainty. For these reasons, the Effects Analysis must provide clear guidance for conceptual models, monitoring, metrics that assess underlying ecosystem processes, explicit thresholds and triggers, alternative hypotheses, special studies to address critical information gaps, and structured decision making in the form of a rigorously institutionalized adaptive

management process.

The third major theme of this review is the lack of an integrated or quantitative assessment of net effects, echoing a similar review comment in the Phase 2 review. The Panel acknowledges that considerable effort has been made in documenting the complex information used to determine net effects. However, in the case of covered species, effects could not be quantified and only two of the sixteen existing life cycle models were deemed to be relevant to BDCP. For these and other reasons, a systematic approach to synopsise the overall net effect on each species was not used. Instead, professional judgment was used instead of a ranking approach to quantify a synthesis of cumulative effects and associated certainty in the projected outcome. Finally, in one paragraph, Chapter 5 accurately portrayed the anticipated BDCP effects: *“These expectations represent a working hypothesis of the relationship between actions, stressors, and biological performance”*. However, this statement was not emphasized throughout the document.

The fourth major theme reflected on the need to address the extensive uncertainties associated with the assumptions and predictions of the beneficial effects of the BDCP conservation measures. While the Phase 2 Effects Analysis accurately reflected the detailed process and implementation structure to apply an adaptive management approach to resolve uncertainties, the Panel was concerned that it defaulted to rather “passive learning” instead of a rigorous, institutionalized adaptive management process that resolved effects on covered species and their requisite ecosystems through an active, experimental approach.

Together with background obtained during Phase 1 and 2 of the BDCP Effects Analysis review, the Panel provides the following synopsis of the Panel’s responses to their General Charge Questions; further responses to specific issues and the adequacy of supporting documents are provided in the body of the report.

1. How well does the Effects Analysis meet its expected goals?

The Phase 3 review-version of the Effects Analysis is a much improved and impressive compilation of background material and scientific and technical knowledge about the Bay-Delta that provides a plausible basis for the conservation measures. The Panel concluded that much of the available data and arguments for the rationale behind the Effects Analysis assumptions and conclusions are contained within the BDCP documents. However, we suggest that the Effects Analysis (Chapter 5) itself is still poorly substantiated and leaves too much to appendices and other BDCP chapters without explicit cross-references. The lack of accessibility to information within the chapter or clear reference to supporting detail inhibits rather than elucidates comprehension of the findings and thus conveys an unsatisfying “trust us” message.

Our conclusion of the Effects Analysis is that many of the critical assumptions in modeling effects and justifications behind the supposed benefits of the conservation measures are highly uncertain. Much of the conservation measures center around restoration activities and management actions to improve current conditions. Our impression, therefore, is that the foundation of the BDCP is weak in many respects and the default burden to ensure covered species benefit, if not recovery, depends on adaptive management. The adequacy of the BDCP therefore rests not in the intent and development of the conservation measures, but in the rigor and application of

adaptive management to ensure that the critical uncertainties are addressed and strategically incorporated into a progressively refined Plan.

2. How complete is the Effects Analysis; how clearly are the methods described?

Chapter 5 provides a comprehensive overview of the spatial and temporal scope of the analysis, definitions of project baselines that differ depending on regulatory authority, recognition of climate change information, identification of a variety of models used to evaluate effects, treatment of viable salmon population criteria, and the approach to determining net effects on fish and wildlife. As might be expected, with the size of the Effects Analysis task, the quality of the assessments ranged in scientific rigor based on the amount of available data and best available science. Some aspects of the assessment, such as water quality and flow, were quantitatively assessed using sophisticated mathematical models. Some aspects of the Chinook salmon assessments were also based on empirical data and process-based models. However, for many of the other fish species and their potential stressors, conceptual models supported by the scientific literature were the only recourse.

3. Is the Effects Analysis reasonable and scientifically defensible? How clearly are the net effects results conveyed in the text, figures and tables?

The approach to net effect conclusions needs to be reconsidered and revamped. The Effects Analysis assessment of net effects, particularly for covered fish, tries to incorporate information on potentially beneficial or detrimental effects covering 12 different stressors, 32 attributes, and multiple life stages using best available information and science. Only a perfect life-cycle model with perfect information on all the effects and their interactions could possibly weight the results correctly and draw unambiguous conclusions. A serious limiting factor of the current consolidation of Net Effects is a near complete absence of any weighting of the biological importance to particularly sensitive life history stages of the many attributes under consideration. As a result, whether and how any critical life stages or attributes are being adversely affected by the BDCP is generally unclear. The net effects conclusions for a fish species needs to therefore take into account the relative importance of the various life history stages, make them explicit, and interpret Plan effects within that context on a species-by-species basis. Similarly, the simple summation of the number of acres of suitable habitat that are removed or restored for each species by the conservation measures does not consider landscape-level effects such as connectivity and patch size, nor does it take into account variation in habitat quality.

The net effects analysis tends to overreach conclusions of positive benefits for covered fish species, given the inability to quantify the over-all net effects and the realization of high uncertainty. In particular, it does not adequately defend conclusions regarding the net effects of habitat restoration. Restoration of tidal wetlands (and other communities) is highly uncertain and at least an extremely long process. The Effects Analysis does not adequately justify the critical assumption of the benefit of tidal wetland restoration as a food web subsidy for covered pelagic fish given the uncertainties of tidal wetland restoration itself. A critical issue is the implicit expectation that restoration activities will result in increases in abundance of lower trophic levels, but it is uncertain whether the resulting increased production will result in food web pathways supporting covered species. The presentation of phytoplankton-based and tidal wetland macrophyte

detritus-based food webs as alternative ecosystem processes, rather than as an integrated system, also significantly complicates the interpretation of the potential benefit of BDCP restoration. For foraging salmonids, the Effects Analysis did not evaluate the reduced extent to which salmonids would have access to rehabilitated habitat when the north Delta intakes are operating and flows are reduced.

Only one configuration of Restoration Opportunity Areas (ROAs) were modeled by the hydrodynamic models and the locations of these assumed Restoration Opportunity Areas are not available. Some details of the hydrodynamic modeling, especially where 1D and 2D models did not agree or situations where counter-intuitive results were reported, could not be evaluated due to the limited information provided.

4. How well is uncertainty addressed? How could communication of uncertainty be improved?

A broad consensus exists among the Panel that Chapter 5 does not adequately acknowledge the extensive uncertainty associated with the BDCP's assumptions and predictions. In its current form, at the level of detail conveyed, in the models used, and in the verbal assessments and conclusions, the level of uncertainty is often downplayed. Within appendices sometimes more explicit discussion of uncertainties can be found, but there is a disconnect between the summary pages with the conclusions drawn in Chapter 5. In situations in which an array of outcomes may be possible, only the more beneficial outcomes are used in conclusions about the BDCP. Communication of uncertainty would be improved by consideration of a range of potential outcome values in models.

5. How well does the Effects Analysis describe how conflicting model results and analyses in the technical appendices are interpreted?

The Panel found models describing salmonid Delta passage and habitat suitability for terrestrial species to be appropriate and any conflicting results adequately explained. Because hydrodynamic models are sensitive to how the open water regions are represented and how they are connected to the adjacent channels, and because the panel was not provided the bathymetric configuration of the ROAs or the order in which the ROAs were established, it is not feasible for the Panel to evaluate the sensitivity of the models to the placement of the Restoration Opportunity Areas.

Overall, the Panel found the Chapter 5 text describing the two life cycle models (IOS and OBAN), which provide alternative views of BDCP effects compared with other analyses, to be complicated and somewhat confusing. It was not clear whether or not the models were appropriately applied to evaluate a portion of the BDCP attributes.

The Effects Analysis modeling of salmon sensitivity to water temperature during egg incubation in the Sacramento River is not clear, given that the BDCP has no effect on upstream conditions according to some sections of Chapter 5. The Chapter 5 evaluation needs clarification, including a clear description of how the BDCP might affect flow and temperature in this area.

6. How well does the Effects Analysis link to the adaptive management plan and associated monitoring programs?

While both the need for and operative structure of adaptive management is identified considerably more in the Phase 3 review version of the Effects Analysis, it remains

characterized as a silver bullet but without clear articulation about how key assumptions will be vetted or uncertainties resolved to the point that the BDCP goals and objectives are more assured. The concept of adaptive management is appropriately described and allocated a prominent role in the implementation structure. However, the commonly acknowledged process of adaptive management is easily misunderstood and misapplied, often resulting in a loss of rigor and commitment in application. Because of the extensive uncertainties surrounding the assumptions and predictions of the BDCP, the Panel strongly emphasizes institutionalizing an exceedingly rigorous adaptive management process. This is critical in order to avoid the high risk associated with ecological surprises that will be difficult or impossible to reverse once they have occurred. BDCP must make a commitment to the fundamental process, and specifically the required monitoring and independent science review, not just the concept of adaptive management.